
इंटेलीजेंट परिवहन पद्धति (आई टी एस) :
रिवर्स पार्किंग अलर्ट पद्धति (आर पी ए एस)

**Intelligent Transport Systems (ITS) :
Reverse Parking Alert System
(RPAS)**

ICS 35.240.60; 43.040.15

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Intelligent Transport Systems Sectional Committee had been approved by the Transport Engineering Division Council.

This standard is a technical document which covers the basic architecture and the test requirements of a Reverse Parking Alert System (RPAS) with integrated camera, sensor, display, HMI, etc. The vehicle level validation for RPAS with integrated camera, sensor and display is covered in Annex A and Annex B of this standard. The component level validation for RPAS is covered in Annex C.

In the formulation of this standard, considerable assistance has been derived from the following standards:

ISO 7637-2 : 2004	Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only
ISO 16750-2 : 2010	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads
ISO 16750-4 : 2010	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads
ISO 10605 : 2008	Road vehicles — Test methods for electrical disturbances from electrostatic discharge
AIS 004 (Part 3)	Automotive Vehicles — Requirements for Electromagnetic Compatibility
AIS 028	Code of Practice for use of CNG fuel in internal combustion engine vehicle
AIS 145	Additional Safety features for Category M & N Vehicles
AIS 053	Automotive Vehicles — Types — Terminology

The composition of the Committee and the Panel responsible for the formulation of this standard is given at Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

INTELLIGENT TRANSPORT SYSTEMS (ITS) : REVERSE PARKING ALERT SYSTEM (RPAS)

1 SCOPE

1.1 This Indian Standard defines the basic architecture and performance requirements of a Reverse Parking Alert System (RPAS) which uses object-detection devices (sensors) or camera based displays in order to provide the driver with information about obstacles in specified zone while reversing the vehicle. The test objects in this standard are defined based on systems using ultrasonic sensors and electromagnetic sensors which reflect the most commonly used technology. For other sensing technologies possibly coming up in the future, these test objects shall be checked and changed if required.

1.2 The requirements of vehicle reverse parking alert system of this standard shall be applicable to all M and N category vehicles, as defined in AIS-053.

1.3 Incomplete vehicles of M, N category, where the cabin build level of the incomplete vehicle prevents the fitment of the reverse parking alert system, the vehicle manufacturer shall provide these items as a kit along with the vehicle and accompanied with suitable guidelines to facilitate the body builder in installing the system as per type approval. While carrying out component testing appropriate mock-up of vehicle rear or test bench simulating sensor installation condition shall be used.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

<i>IS No.</i>	<i>Title</i>
2465 : 1984	Specifications for cable for motor vehicles
IS 4905 : 2015/ ISO 24153 : 2009	Random Sampling and Randomization Procedures
9000 (Part 2/Sec 4) : 1977	Basic environmental testing procedures for electronic and electrical items: Part 2 Cold test, Section 4 Cold test for heat dissipating items with gradual change of temperature

IS No.

Title

9000 (Part 3/Sec 5) : 1977	Basic environmental testing procedures for electronic and electrical items: Part 3 Dry heat test, Section 5 Dry heat test for heat dissipating items with gradual change of temperature
9000 (Part 5/Sec 2) : 1981	Basic environmental testing procedures for electronic and electrical items: Part 5 Damp heat (cyclic) test, Section 2 + 12 h Cycle
9000 (Part 7) : 2006	Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test
9000 (Part 8) : 1981	Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test
IS 10250 : 1982	specification for severities for environmental test for automotive electrical equipment
IS/IEC 60529 : 2001	Degrees of protection provided by enclosures (IP CODE)

3 ABBREVIATIONS

<i>Abbreviation</i>	<i>Description</i>
BIS	Bureau of Indian Standards
DUT	Device Under Test
e.g.	for example
etc.	et cetera (and the rest)
HMI	Human Machine Interface
RPAS	Reverse Parking Alert System

4 TERMS, DEFINITIONS AND NOMENCLATURE

For the purpose of this standard the following definitions shall apply.

4.1 Ratings — The voltage and current range at which the RPAS is designed to operate satisfactorily.

4.2 Type Approval Tests — Tests carried out to prove conformity of RPAS with respect to the requirements of this standard. These are intended to prove the general quality, design and performance of a given type of RPAS.

4.3 Acceptance Tests for Conformity of Production — Tests required to be carried out on samples taken from a lot for the purpose of acceptance of the lot for establishment of compliance of component from the production series which has already been type approved, to the provisions of the notified standard.

4.4 Lot — Fifty numbers of RPAS of the same type, design, rating, manufactured in the same premises, using the same process and materials, offered for inspection at a time shall constitute a lot.

4.5 Functional Status Classification — Operational status of a device during and after exposure to an electromagnetic environment.

4.6 Device — Device is a component implementing one or more RPAS functions mentioned in this standard.

4.7 Reverse Parking Alert System (RPAS) — System that is designed to alert/display the driver about obstacles on the rear side of vehicles while parking in reverse gear.

4.8 Audible Information and Warning — Acoustical signal that is used to present information about relevant obstacles, to the driver, for example, pulses, speech, etc.

4.9 Visual Information and Warning — Optical signal which is used to present information about relevant obstacles to the driver, for example, telltale, display, etc.

4.10 Monitoring Range — Monitoring range is space at the rear side of the vehicle, which is divided into following zones:

- a) Rear-1 (R1), and
- b) Rear-2 (R2).

4.11 Reversing Detection System — System that gives an indication to the driver, when the reverse gear is selected, whether there are objects in the rear monitoring range.

4.12 Sensor — Component that detects objects in the monitoring range

4.13 System Activation Ratings — Action of transitioning the system operation from a non-active mode to an active mode in which the system is monitoring the rear monitoring ranges, evaluating the objects detected and generating appropriate feedback to assist the driver.

4.14 Test Object — Object with a specific material, geometry and surface for testing the monitoring range.

4.15 Rear View Camera — Video camera which can continuously monitor the zone just behind the vehicle when activated.

4.16 Frame Height — Height of the upper flank of the chassis frame at rear end of vehicle from the ground.

4.17 HMI/Driver Console — Human machine interface which allows user to select various options in software or modes of software.

NOTE — The word ‘function’ in this context refers only to the function performed by the electronic system

5 CLASSIFICATION OF FUNCTIONAL STATUS

Following classifications are for the total device/system functional status:

- a) *Class A* — All functions of a device/system perform as designed during and after exposure to disturbance.
- b) *Class B* — All functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions shall remain Class A.
- c) *Class C* — One or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
- d) *Class D* — One or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple ‘operator/use’ action.
- e) *Class E* — One or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

NOTE — The word ‘function’ in this context refers only to the function performed by the electronic system.

6 REQUIREMENTS

6.1 Vehicle reverse parking alert shall meet requirements of Annex A for vehicle of M1 category and M2 category derived from M1.

6.2 Vehicle reverse parking alert shall meet requirements of Annex B for vehicles other than M1 category.

All vehicles other than M1 equipped with vehicle reverse parking alert shall comply with the requirements of Annex B of this standard. To address the diversity

of vehicle heights and rear end configuration, it shall be permissible for vehicles of category other than M1 to comply with the requirements of Annex A as an alternative. Tractors including Puller tractors of N category shall be exempted from the requirements of both Annex A and Annex B.

6.3 Component level validation requirements shall meet requirements of Annex C:

- a) *Annex A* — Requirements for vehicle reverse parking alert system (applicable for category M1, M2 derived from M1).
- b) *Annex B* — Requirements for vehicle reverse parking alert system (applicable for category M and N not covered by Annex A).
- c) *Annex C* — Component level validation.

Additionally, manufacturer may need to submit data which may be relevant to application for approval, for example, frame height when seeking exemption.

7 MARKING

The RPAS shall have the following information marked indelibly and legibly at an easily accessible location:

- a) Name and/or trade-mark of the manufacturer,
- b) Model number (if any),
- c) Unique identification number, and
- d) Country of manufacture (if required).

8 TECHNICAL INFORMATION TO BE SUBMITTED BY VEHICLE MANUFACTURER

A General Information

- 1 Name and address of vehicle manufacturer

- 2 Vehicle model and its variant(s)
- 3 Vehicle overall dimensions, (length, width and height), mm
- B Information for Reverse Parking Alert System**
 - 1 Type of system (sensor based/camera based system)
 - 2 Sensor based system (as applicable) information
 - 2.1 Make
 - 2.2 Identification No. / Part No.
 - 2.3 Number of sensors and mounting location
 - 3 Camera based system (as applicable)
 - 3.1 Make
 - 3.2 Identification No. / part No.
 - 3.3 Camera mounting location
 - 3.4 Display make
 - 3.5 Display identification No. / part No.
 - 3.6 Display location

9 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(Foreword and Clause 5.1)

REQUIREMENTS FOR VEHICLE REVERSE PARKING ALERT

(Applicable for category M1, M2 derived from M1)

A-1 FUNCTIONAL AND PERFORMANCE REQUIREMENTS

A-1.1 System Activation and Deactivation

A-1.1.1 The system is activated/ deactivated automatically according to the driving situation.

A-1.1.2 Activation criteria is reverse gear being selected. Deactivation criteria is gear other than reverse being selected.

A-1.1.3 The system may have on/off switch or push button to override automatic (de)activation.

A-1.1.4 In order to reduce annoyance of the driver, the system may automatically switch off the audible signal temporarily after a certain time (duration can be defined by manufacturer). The system, however shall remain in active state.

A-1.1.5 On vehicles with automatic transmission the system may be deactivated if the P (parking) gear position is selected.

A-1.1.6 It may be allowed to deactivate the system while the parking brake is engaged.

A-1.2 Parking Alert Information

A-1.2.1 The rear parking alert system shall give an acoustic signal to warn the driver on the obstacles detected in the monitoring range in case of sensor based system. The system may have optical warning as supplementary alert to warn the driver. In case of camera based systems, obstacle within monitoring range shall be visible to driver. Additionally vehicle manufacturer may provide acoustic warning or optical warning or both.

A-1.2.2 Duration of Signaling

In general, signaling an obstacle shall be maintained as long as the obstacle is detected and shall cease when the obstacle is no longer detected or the system is deactivated. Provided that provisions under A-1.1 shall be permitted.

A-1.3 Monitoring Range Coverage

Rear parking alert system shall meet the performance requirements described in Table 1. Vehicle shall be in normal condition during the verification.

The horizontal areas of relevance are the two dimensional projections of the monitoring ranges on

to the driveway. The minimum detection distances as measured from the vehicle boundary are defined in Table 1.

Table 1 Rear Parking Alert-Monitoring Range and Detection

(Clause A-1.3)

Sl No.	Monitoring Range	Detection Distance (M1)
(1)	(2)	(3)
i)	Rear-1 (R1)	0.6 m
ii)	Rear-2 (R2)	1.0 m

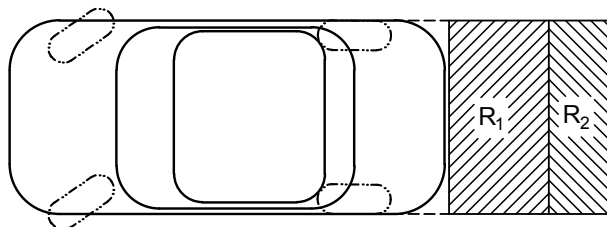


FIG. 1 PICTORIAL REPRESENTATION OF ZONES

A-1.3.1 Method of Evaluation of Horizontal Coverage

The first 0.2 m starting from the vehicle boundary (see Fig. 2) shall not be tested, because state-of-the-art sensing technology cannot guarantee detection in this close proximity.

In order to perform the operational test the relevant monitoring range shall be scanned horizontally with test object H as specified in 3. Each detected grid position is represented by a covered square with edge lengths of dx and dy (dx = 0.1 m, dy = 0.1 m for testing the horizontal coverage) and its center at the position of the longitudinal axis of the standard obstacle. The grid is explained in Fig. 3.

A-1.3.2 The monitoring range is divided into two ranges, 'A1' that extends from the vehicle boundary up to 0.6 m and 'A2' which covers the range beyond 0.6 m till 1.0 m. 'A' is the distance starting from the vehicle boundary. The width of the rectangle is equal to the vehicle width, measured along the rear axle. The dimensions shall be rounded up to the nearest 0.1 m. The grid is arranged symmetrically to the vehicle centre line. (see Fig. 2) Figure 3 explains location of test object within grid.

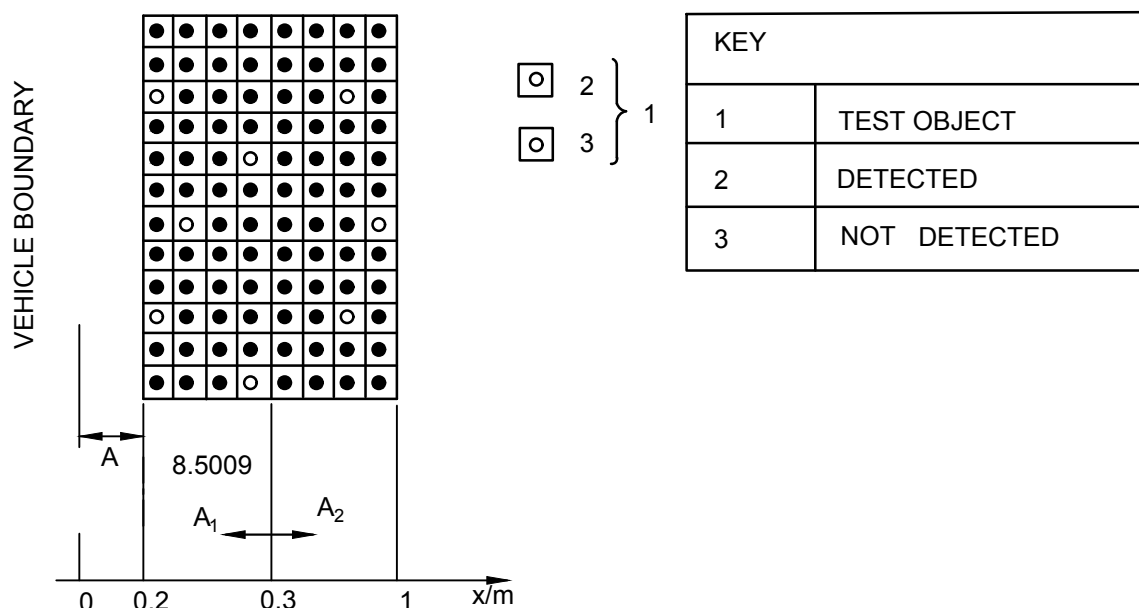


FIG. 2 DETERMINATION OF THE REAR HORIZONTAL COVERAGE RATIO IN THE SUB-AREAS A1 AND A2

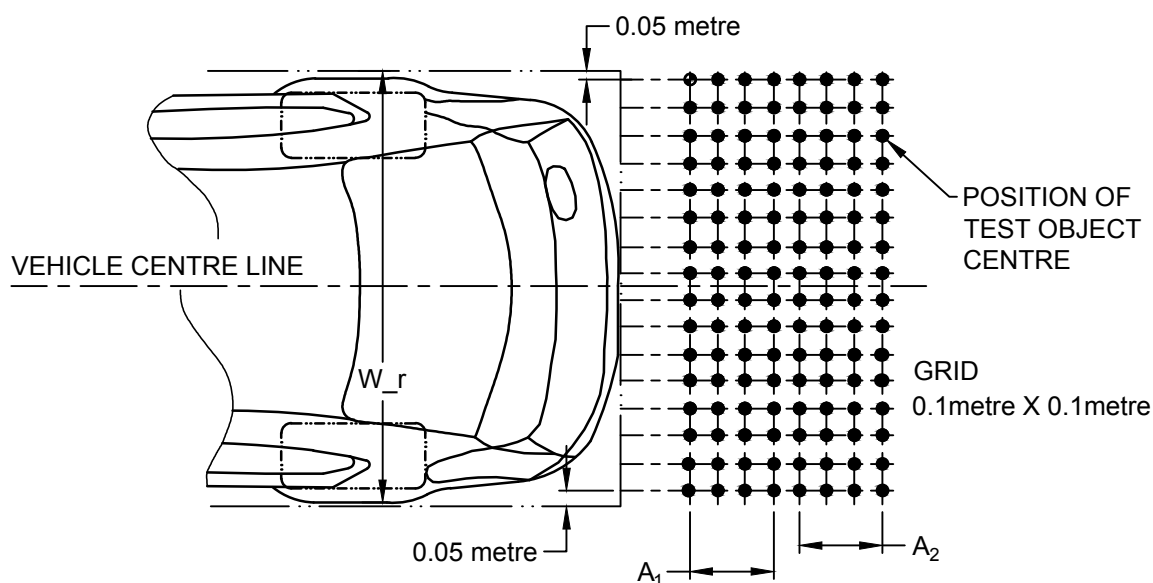


FIG. 3 GRID POSITIONS FOR TESTING THE HORIZONTAL COVERAGE OF THE REAR MONITORING RANGE

The coverage ratio is defined as the ratio of the covered area over the total area of relevance. For example, for a total area of relevance of 90 cells with a covered area of 78 cells, the average coverage ratio is 87 percent. The area of a single detection hole is defined as the dx^2 corresponding to a 'not detected' standard obstacle. The result shall be rounded off to nearest full number.

A-1.4 Monitoring Range — Horizontal Coverage

A-1.4.1 Requirements for Sensor Based System

A-1.4.1.1 The minimum required coverage ratios for the rear horizontal areas of relevance are as follows when tested as per A-1.3.1 and A-1.3.2:

- 87 percent in area A1 (Zone R1); and
- 87 percent in the area A2 (Zone R2).

A-1.4.1.2 Requirements for camera based system

The display visible to driver from normal driving position shall show at least 87 percent test objects (by number) when tested as shown in Fig. 3.

Alternately, the display visible to the driver from normal driving position shall show full vision on ground as per Fig. 3 where dimension 'A' is 0.3 m (Refer Fig. 2 for 'A').

A-1.4.2 The system can use either sensor or camera based solutions or any other system for compliance to requirements. In case vehicles are provided with alert as well as display, manufacturer may choose to meet either of the requirements specified for sensor based system or camera based system as per his discretion.

A-1.4.3 Test Setup

Perform the operational test on a vehicle or test structure that allows the installation conditions of the selected vehicle model or selected vehicle range to be reproduced. In case a vehicle is used to perform the test, it shall have kerb weight. A tolerance of ± 5 percent shall be allowed on kerb weight. If the ride height is adjustable, it shall be set to normal driving condition on paved roads. Sensor surfaces shall be visibly clean and free of contamination.

A-1.4.4 Reverse Parking Alert System shall meet the requirements of Annex C of this standard at electronic sub-assembly (ESA) level.

A-2 GENERAL AMBIENT CONDITIONS

During testing, the wind speed shall not exceed 5.4 m/s (wind force 3). Temperature shall be within 15°C to 40°C under non-precipitating conditions (not raining, sleeting, snowing, etc.). The test location shall be on a flat, dry, asphalt or concrete surface. The tests shall not be affected by reflections, neither of sonic nor of electromagnetic waves from walls in the environment, auxiliary test equipment or other objects.

Table 2 Test Objects

(Clause A-2)

Sl No.	Monitoring Range	Material	Diameter	Length
(1)	(2)	(3)	(4)	(5)
(i)	All horizontal areas test object H	Metal	75 mm	1+0.2 m

ANNEX B

(Foreword and Clause 5.2)

REQUIREMENTS FOR VEHICLE REVERSE PARKING ALERT

(Applicable for category M and N not covered under Annex A)

B-1 FUNCTIONAL AND PERFORMANCE REQUIREMENTS**B-1.1 System Activation and Deactivation**

B-1.1.1 The RPAS shall be automatically activated whenever reverse gear is selected and the ignition switch is in ON condition.

B-1.1.2 The RPAS system shall be automatically deactivated whenever a gear position other than reverse gear is selected.

B-1.1.3 It shall not be possible to disable the RPAS by simply switching it off.

B-1.1.4 The audible warning signal shall be maintained as described in 2.4.1

B-1.1.5 On vehicles with automatic transmission the RPAS shall be deactivated if any gear positions other than R (reverse gear) are selected.

B-1.2 Monitoring Range

The monitoring range for RPAS is defined by the measuring points in Fig. 5, 6, 7 and 8 when the vehicle is in fully laden condition.

B-1.3 Arrangement of Sensors

The sensors shall be arranged such that the monitoring range specified in 2.2 is covered.

B-1.4 Indicators and Signals

The RPAS shall be equipped with audible warnings and optionally with visual indicators.

B-1.4.1 Audible Warnings

The audible warnings shall have the functions given below.

B-1.4.1.1 The audible warning signals shall consist of:

- Continuous sequence of individual tones when there are objects in the main warning zone; and
- Continuous tone when there are objects in the collision zone.

B-1.4.1.2 Faults

- The faults in the system shall be indicated by a continuous tone and this tone shall differ markedly from the normal warning tones in its frequencies.
- The warning tone shall have minimum duration of 3 s after selection of reverse gear. After sounding for the required period, the warning shall automatically switch off.

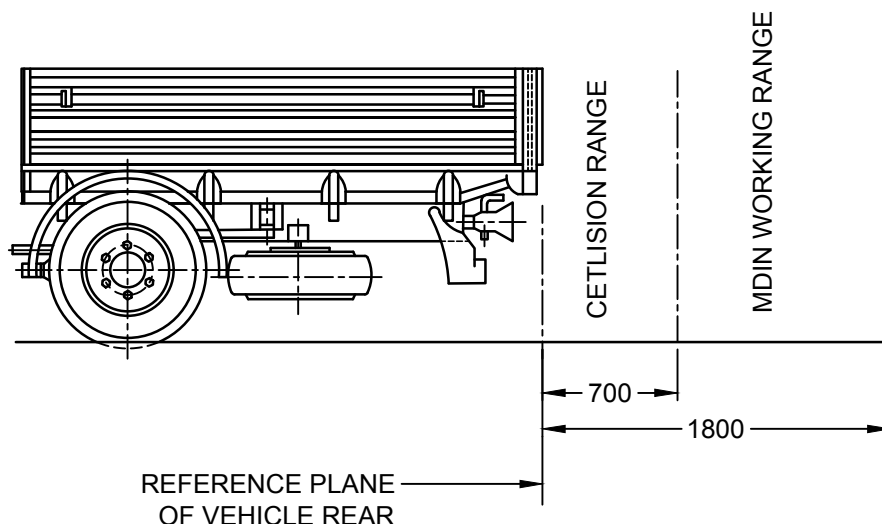


FIG. 4 MONITORING RANGE OF REVERSING DETECTING DEVICES

- c) It shall only sound when the reverse gear is engaged and sound every time this gear is selected as long as the fault remains.
- d) The warning signal shall not be cancelled unless the fault is rectified.

B-1.4.2 Visual Indicators

Visual indicators if fitted shall be readily visible to the driver and may indicate messages related to one or more of the following:

- a) Objects being in the main warning range or collision range,
- b) System activation,
- c) System readiness, and
- d) Faults.

B-1.4.3 The vehicle manufacturer shall provide information on the method of operation of the audible warning and visual indicators in the user manual.

B-1.5 Rear View Camera System (Optional Fitment)

The rear view camera system shall display the zone behind the vehicle where an object may be present.

B-1.6 Component Level Validation

Reverse parking alert system shall meet the requirements of Annex C of this standard at electronic sub-assembly (ESA) level.

B-2 TESTS

B-2.1 General Test Conditions

B-2.1.1 The desirable ambient conditions are:

- a) Ambient temperature: 15 to 40°C;
- b) Relative humidity: 60 ± 25 percent; and
- c) Ambient wind speed: 5.4 m/s (*Max.*)

B-2.1.2 The test shall not be affected by reflected sounds from surrounding walls, auxiliary test equipment or other objects.

B-2.2 Test Object

The monitoring range capability of the RPAS shall be tested with the following test objects:

- a) Test object H for the horizontal test: plastic tube, grey, 75 mm diameter, 1 000 mm length; and
- b) Test object V for the vertical test: plastic tube, grey, 75 mm diameter, 300 mm length.

The material of the tube for the test object may be different from the above specification with agreement between manufacturer and test agency.

B-2.3 Test Procedure

B-2.3.1 Operational tests for compliance to the specified monitoring range shall be performed on a vehicle or on

a test structure on which the installation conditions of the RPAS of the selected vehicle model or model range (in fully laden condition) can be reproduced.

B-2.3.2 Appropriate aids shall be used for identifying the test object positions.

B-2.3.3 A log shall be kept of the test positions where the object is detected and where the object is not detected.

B-2.4 Test 1 — Horizontal Monitoring Range Test

B-2.4.1 Position the test object H (1 m long) such that the axis of the tube is standing perpendicular to the ground and at positions shown in the grid in Fig. 5.

B-2.4.2 The number of measuring points in each row at 200 mm interval as shown in the Fig. 5 is indicative and will depend upon the actual width of the vehicle. Referencing for the measuring point pattern shall be from the center of the vehicle.

B-2.4.3 If the distance from the outermost measuring point of the 200 mm grid to the outer edge of the vehicle is more than 100 mm, an additional measuring point shall be located there.

B-2.4.4 In the case of tippers, the 1.8 m monitoring range shall be measured from the face of the sensor mounting. Any projections of the tipping superstructure behind the sensor mounting surface shall be ignored.

B-2.4.5 The fraction obtained by dividing the number of points at which the test object is detected by the total number of points at which it is placed shall be at least 0.9.

B-2.5 Test 2 — Vertical Monitoring Range Test

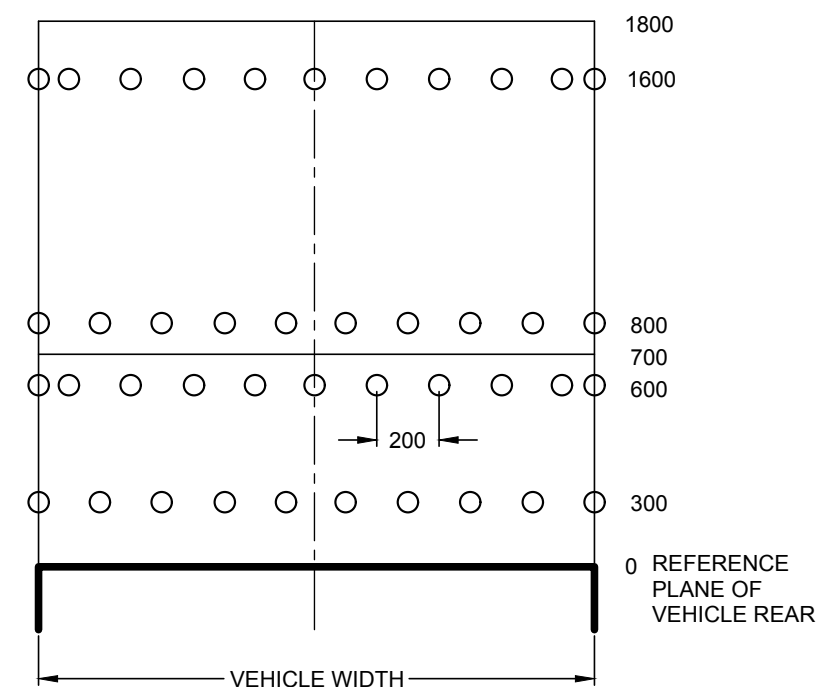
B-2.5.1 Position the test object V (300 mm long) so that the axis of the tube is static and parallel to the ground and its longitudinal center is at the grid measuring points shown in Fig. 6 and Fig. 7 as applicable.

B-2.5.2 The detection of test object V shall be checked at all indicated positions of the test planes at 500 mm, 800 mm and 1 100 mm, as applicable (*see* Fig. 8).

B-2.5.3 In case of vehicles where the frame height does not exceed 800 mm, the test at 1 100 mm level shall not be performed and in case of vehicles where the frame height exceeds 800 mm, the test at 500 mm level shall not be performed. Frame height shall be measured up to the topmost point of the frame from ground.

B-2.5.4 Further RPAS fitted on tippers need not provide any detection at 500 mm level (*see* Fig. 8).

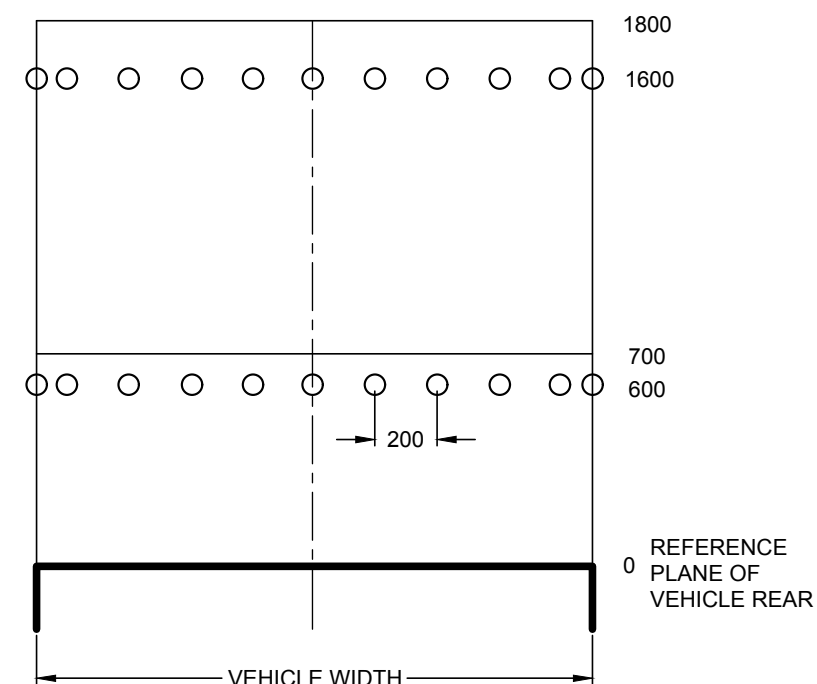
B-2.5.5 Finally, the fraction obtained by dividing the number of points at which the test object is detected by the total number of points at which it is expected to be detected shall be at least 0.9.



O Grid position of object h when standing perpendicular to ground

All dimensions in millimetres

FIG. 5 TEST MONITORING RANGE TEST (PLAN VIEW)

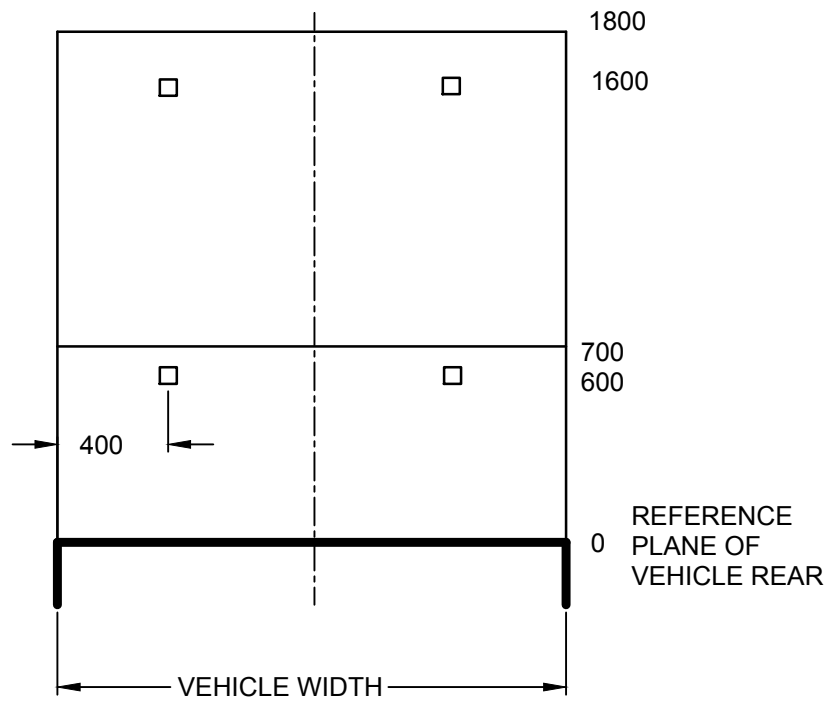


O Grid position of object h when standing perpendicular to ground

All dimensions in millimetres

NOTE — For side view see Fig. 8.

FIG. 6 TEST 2 — VERTICAL MONITORING RANGE TEST (PLAN VIEW)
(FOR 500 AND 800 mm PLANES)

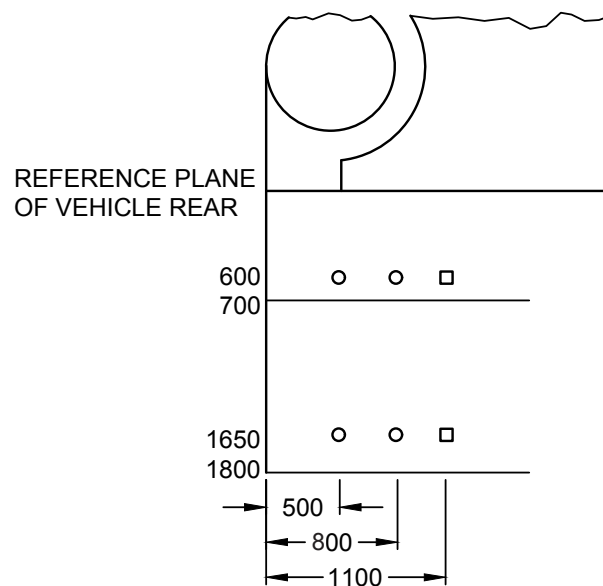


All dimensions in millimetres

Grid Position for lateral placement of Test Object V at 1 100 mm plane parallel to ground

NOTE — For side view see Fig. 8.

FIG. 7 TEST 2 — VERTICAL MONITORING RANGE TEST (PLAN VIEW)
(FOR 1 100 mm PLANE)



All dimensions in millimetres

NOTES

1 See Fig. 6 for plan view.

2 See Fig. 7 for plan view.

FIG. 8 TEST 2 — VERTICAL MONITORING RANGE TEST (SIDE VIEW)

ANNEX C

(Foreword and Clause 5.3)

COMPONENT LEVEL VALIDATION

C-1 ENVIRONMENTAL TESTS

C-1.1 Dry Heat / High Temperature Test

The high temperature test is used to evaluate effects of high temperature conditions on safety, integrity, and performance of the device. The test shall be carried out in accordance with IS 9000 (Part 3/Sec 5) the device shall be subjected to temperature of $70 \pm 2^\circ\text{C}$ for 16 h in high temperature. Test with device in working condition. The recovery period shall be 2 h.

Acceptance Criteria: Device during and after the high temperature test the device shall meet functional class A.

C-1.2 Cold Test

The test shall be carried out in accordance with IS 9000 (Part 2/Sec 4). The device under test shall be subjected to temperature of $-10 \pm 2^\circ\text{C}$ for 2 h with device in working condition. The recovery period shall be 2 h.

Acceptance Criteria: Device during and after the cold test, the device shall meet functional class A.

C-1.3 Damp Heat Test

The device under test shall be tested according to IS 9000 (Part 5/Sec 2). The test is carried out at $+25^\circ$ to $+55^\circ\text{C}$, humidity 95 percent. Six cycles (each test cycle of 24h) shall be run with device in off condition. Functional test shall be carried out with power in 'on condition' at start of 2nd, 4th and 6th cycle.

Acceptance Criteria: Device during and after the test the device shall meet functional class A.

C-1.4 Temperature Shock

Temperature shock test is carried out to determine if the device can withstand sudden changes in the temperature of the surrounding atmosphere without experiencing physical damage or deterioration in performance. Exposure time at temperature extremes -10°C and 70°C would be 3 h/cycle and number of cycles would be two.

Acceptance Criteria: Device after the test the device shall meet functional class A.

C-1.5 Salt Spray Test

The salt spray test is conducted to check corrosion resistance of device. The device shall be tested according to 4.8 of IS 10250 for 96 h.

Acceptance Criteria: The device shall meet functional class A.

C-1.6 High Voltage Test

The test is conducted to ensure service life requirements and functionality. The device under test shall be operated for 60 min at 18V for 12V systems and 36 V for 24 V systems. This test is as per ISO 16750-2.

Acceptance Criteria: Device during and after the test the device shall meet functional class A.

C-2 DURABILITY AND PERFORMANCE TESTS

C-2.1 Shock Test

This test is performed to provide a degree of confidence that the device can physically and functionally withstand the relatively infrequent, non-repetitive shocks encountered in transportation environments.

This test provides an assessment of the effect of shocks on the performance of the device. The test shall be performed as per IS 9000 (Part 7).

Severity level = 15 g,

Impact duration = 11 ms,

Impact Type = Half sine,

Total number of impact = 9 (3 on each axis)

Acceptance Criteria: Device after the shock test shall meet functional class A.

C-2.2 Vibration Test

This test is performed to check that the device can physically and functionally withstand the vibration exposures in the life cycle typically encountered in a vehicular environment. The test shall be performed as per IS 9000 (Part 8). The test specimen mounted on a suitable support shall be rigidly fixed on a suitable vibrating machine constructed to produce simple harmonic function (total amplitude of 1.5 mm) and shall be subjected to vibration through a frequency range of 10-55-10 Hz in a sweep period of 1 min with continuously varying frequencies. The vibration shall be applied for not less than 1 h in the directions of each of the 3 major axes of the light.

Acceptance Criteria: During and after the test the device shall meet functional class A.

C-2.3 Ingress Protection (IP)

The device must be able to work in dusty environment that are typically encountered by the vehicles where these would be installed. IP rating (IS/IEC 60529 : 2001)

is used for specifying the environmental protection characteristics of the device.

The device shall be tested for dust and water ingress as per following requirement:

IP	Dust	Water	
	6	5	7
	Dust tight	For internal parts for example, display, controller	For exterior parts for example, Sensors, camera

Acceptance Criteria: The device shall meet functional Class A and no ingress shall be observed.

C-2.4 EMI/EMC Test

The electromagnetic interference (EMI) and electromagnetic compatibility (EMC) tests are performed to assess whether the device performs its intended functions in the electromagnetic environment to which it would be exposed. Further, the device shall not generate electromagnetic disturbances that may influence other equipment in the vicinity.

Acceptance Criteria: The device shall meet the EMI/EMC requirements as per AIS 004 (Part 3).

C-2.5 ESD Test

The device to be tested shall be subjected to tests as per ISO 10605. The minimum and maximum test signal severity levels shall be as mentioned below:

Sl No.	Type of Tests	Minimum	Maximum
1) Powered condition	Direct contact discharge	± 6 kV	± 8 kV
	Direct air discharge	± 6 kV	± 8 kV
2) Unpowered condition	Direct contact discharge	± 8 kV	± 15 kV
	Direct air discharge	± 8 kV	± 15 kV

Acceptance Criteria: Device shall meet the functional status of class C during and after the discharge.

C-2.6 Load Dump Test Pulse 5a

As per standard ISO 7637-2 : 2004:

For 12 V System: A Voltage spike of 65V, 4 Ω, 200 ms

For 24 V System: A Voltage spike of 123V, 8 Ω, 200 ms

Acceptance Criteria: Device shall meet functional class A as per ISO 7637-2: 2004. After test, the device shall meet functional class A.

C-2.7 Reverse Polarity Protection Without Fuse

The device to be tested shall be connected to a reversed voltage of 14 V for 12 V systems and 27 V for 24 V

systems for 2 min after connecting the system to the suitable circuit.

Acceptance Criteria: After test; the device shall meet functional class A.

C-2.8 Performance Parametric Test (Nine Points, Tri Temperature/Tri Voltage)

During testing, device shall be kept inside test chamber in power ON condition (system shall be stabilized for minimum 5 min at each condition. At each test point the system will be powered on and shut down 5 times with a duration of 1 min ON and 1 min OFF time). Following are the various voltages and temperatures:

24V System	12V System
18V, -25°C	9V, -25°C
18V, +80°C	9V, +80°C
18V, Room temperature	9V, Room temperature
27V, -25°C	13.5V, -25°C
27V, +80°C	13.5V, +80°C
27V, Room temperature	13.5 V, Room temperature
32V, -25°C	16V, -25°C
32V, +80°C	16V, +80°C
32V, Room temperature	16V, Room temperature

Acceptance Criteria: The device shall meet functional class A.

C-2.9 Insulation Resistance Test

Test shall be conducted as per ISO 16750-2 : 2010 after damp heat test mentioned in point 3 of the section 6.4. System/components shall remain 0.5 h at room temperature after the damp heat test. Test shall be conducted with a voltage of 500 V DC.

Acceptance Criteria: Insulation Resistance shall be > 1 MΩ. No arcing or puncturing of insulation allowed shall meet functional Class A

C-2.10 Wiring Harness — Flammability Test

The wiring harness used in the device shall be tested for flammability as per IS 2465.

C-2.11 Wiring Harness — Electrical Properties

As per AIS 028 or DIN72551 or ISO 6722.

C-2.12 Free Fall

IS 9000 (Part 7/Sec 4) free fall from 500 mm.

Acceptance Criteria: After test the device shall meet functional class A

C-3 CRITERIA FOR TYPE APPROVAL

Minimum six samples shall be submitted for testing together with the relevant data. The testing authority

shall issue a type approval certificate if the device is found to comply with the requirements of the type approval tests.

The samples shall be tested as per the test sequence given in Table 3.

The sequence of tests on sample sets S1 to S6 shall be as mentioned in Table 3 and is subject to agreement between manufacturer and the test agency.

In case of failure in one or more type approval tests, the testing authority may call for fresh samples not exceeding twice the number of original samples and subject them to test(s) in which failure occurred. If, in repeated test(s) no failure occurs, the test may be considered to have been satisfactory.

C-4 ACCEPTANCE TESTS FOR CONFORMITY OF PRODUCTION

Following shall constitute acceptance tests:

- High voltage test,
- Reverse polarity protection without fuse,
- Performance parametric test,
- Insulation resistance test,
- Load dump test (pulse 5a), and
- ESD test.

Table 3 Sample-Wise Test Sequence
(Clause C-3)

Sl No.	Tests	Sample Set No.					
		S1	S2	S3	S4	S5	S6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	EMI-EMC	X					
ii)	ESD		X				
iii)	Load dump test, pulse 5a		X				
iv)	Over voltage protection Test						X
v)	Performance parametric test (tri temperature/tri voltage)						X
vi)	High voltage test						X
vii)	Insulation resistance test						X
viii)	Reverse polarity protection without Fuse						X
ix)	Ingress protection			X			
x)	High temperature test				X		
xi)	Temperature shock test					X	
xii)	Cold test					X	
xiii)	Damp heat test				X		
xiv)	Shock test		X				
xv)	Vibration test		X				
xvi)	Salt spray test			X			
xvii)	Test for wiring harness	X					
xviii)	Free fall test				X		

ANNEX D*(Foreword)***COMMITTEE COMPOSITION**

Intelligent Transport Systems Sectional Committee, TED 28

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